Teachers' AI-TPACK: Exploring the Relationship between Knowledge Elements

Abstract

The profound impact of artificial intelligence (AI) on the modes of teaching and learning necessitates a reexamination of the interrelationships among technology, pedagogy, and subject matter. Given this context, we endeavor to construct a framework for integrating the Technological Pedagogical Content Knowledge of Artificial Intelligence Technology (Artificial Intelligence—Technological Pedagogical Content Knowledge, AI-TPACK) aimed at elucidating the complex interrelations and synergistic effects of AI technology, pedagogical methods, and subject-specific content in the field of education. The AI-TPACK framework comprises seven components: Pedagogical Knowledge (PK), Content Knowledge (CK), AI-Technological Knowledge (AI-TK), Pedagogical Content Knowledge (PCK), AI-Technological Pedagogical Knowledge (AI-TCK), AI-Technological Content Knowledge (AI-TPK), and AI-TPACK itself. We developed an effective structural equation modeling (SEM) approach to explore the relationships among teachers' AI-TPACK knowledge elements through the utilization of exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The result showed that six knowledge elements all serve as predictive factors for AI-TPACK variables. However, different knowledge elements showed varying levels of explanatory power in relation to teachers' AI-TPACK. The influence of core knowledge elements (PK, CK, and AI-TK) on AI-TPACK is indirect, mediated by composite knowledge elements (PCK, AI-TCK, and AI-TPK), each playing unique roles. Non-technical knowledge elements have significantly lower explanatory power for teachers of AI-TPACK compared to knowledge elements related to technology. Notably, content knowledge (C) diminishes the explanatory power of PCK and AI-TCK. This study investigates the relationships within the AI-TPACK framework and its constituent knowledge elements. The framework serves as a comprehensive guide for the large-scale assessment of teachers' AI-TPACK, and a nuanced comprehension of the interplay among AI-TPACK elements contributes to a deeper understanding of the generative mechanisms underlying teachers' AI-TPACK. Such insights bear significant implications for the sustainable development of teachers in the era of artificial intelligence.